



Amperex[®] ELECTRONIC CORPORATION
SLATERSVILLE, RHODE ISLAND 02876

HORIZONTAL SWEEP CIRCUIT FOR LOW COST COLOR TV

This circuit is suitable for 1.5 mh to 3 mh yokes requiring approximately 3 ampere peak-to-peak deflection current. The measurements were obtained with a Philips 90° yoke, type AT1022. The closest U.S. type is a Sickles FWS-18707-7 with the horizontal yoke segments reconnected in parallel instead of in series.

A nominal, 260-volt, B+ supply is required with a loading of 220 ma to 310 ma for zero to 850 μ a beam current. The nominal high voltage is 24 kvolts at zero beam current with a 3 megohm supply impedance. The design maximum high voltage is 25.5 kvolts.

A single 6KG6 sweep tube and a 6EC4 damper are used. The oscillator is the pentode section of a 6BL8 (self-reactance circuit), while the triode section is free for use elsewhere in the circuitry. The compensated focus supply uses a 1S2A (or 1BG2) focus rectifier. This part of the circuit can, of course, be simplified by using a high ohmage divider network off the high voltage circuit. A straightforward horizontal centering circuit is also included, operating from the cathode current of the sweep tube. This circuit can also be omitted if component tolerances (in the yoke, etc.) are good enough to warrant omission.

The basic circuit is shown in the schematic of Figure 1. Figure 2 shows the flyback transformer connections and voltages relative to ground at zero beam current. Flyback time is 17%.

MEASUREMENTS

High Voltage	
at Zero Beam Current	24 kvolts
at 850 μ a Beam Current	21.5 kvolts
High Voltage Impedance	3 megohms
Plate Current	
at Zero Beam Current ¹	220 ma
at 850 μ a Beam Current ¹	310 ma
Plate Voltage, Fixed	260 volts

6KG6 Measurements

Peak Cathode Current	
at Zero Beam Current	500 ma
at 850 μ a Beam Current	650 ma
Average Cathode Current	
at Zero Beam Current	215 ma
at 850 μ a Beam Current	310 ma
Grid No. 2 Voltage	
at Zero Beam Current	212 volts
at 850 μ a Beam Current	187 volts
Grid No. 2 Current	
at Zero Beam Current	15 ma
at 850 μ a Beam Current	23 ma
Plate Voltage pulse	6 kvolts
Peak Plate Current	
at Zero Beam Current	560 ma
at 850 μ a Beam Current	670 ma

6EC4 Measurements

Peak Cathode Current	600 ma
Cathode Voltage Pulse	5 kvolts

¹ Including oscillator

HV Variation with Supply Voltage (at 850 μ a Beam Current)

<u>Supply</u>	<u>HV</u>	<u>Plate Current</u>
260 V	21.5 kv	315 ma
230 V	20.8 kv	305 ma
290 V	22.3 kv	320 ma

VDR control bias set for 920 V boost at 260 V line, zero beam current.

HV Variation with supply Voltage (at Zero Beam Current)

<u>Supply</u>	<u>HV</u>
260 V	24.5 kv
230 V	23.7 kv
290 V	25.5 kv

Focus Measurements

	<u>Min</u>	<u>Max</u>
Zero Beam Current, 260 V line	3.7 kv	4.6 kv
850 μ a Beam Current, 260 V line	3.1 kv	4.0 kv

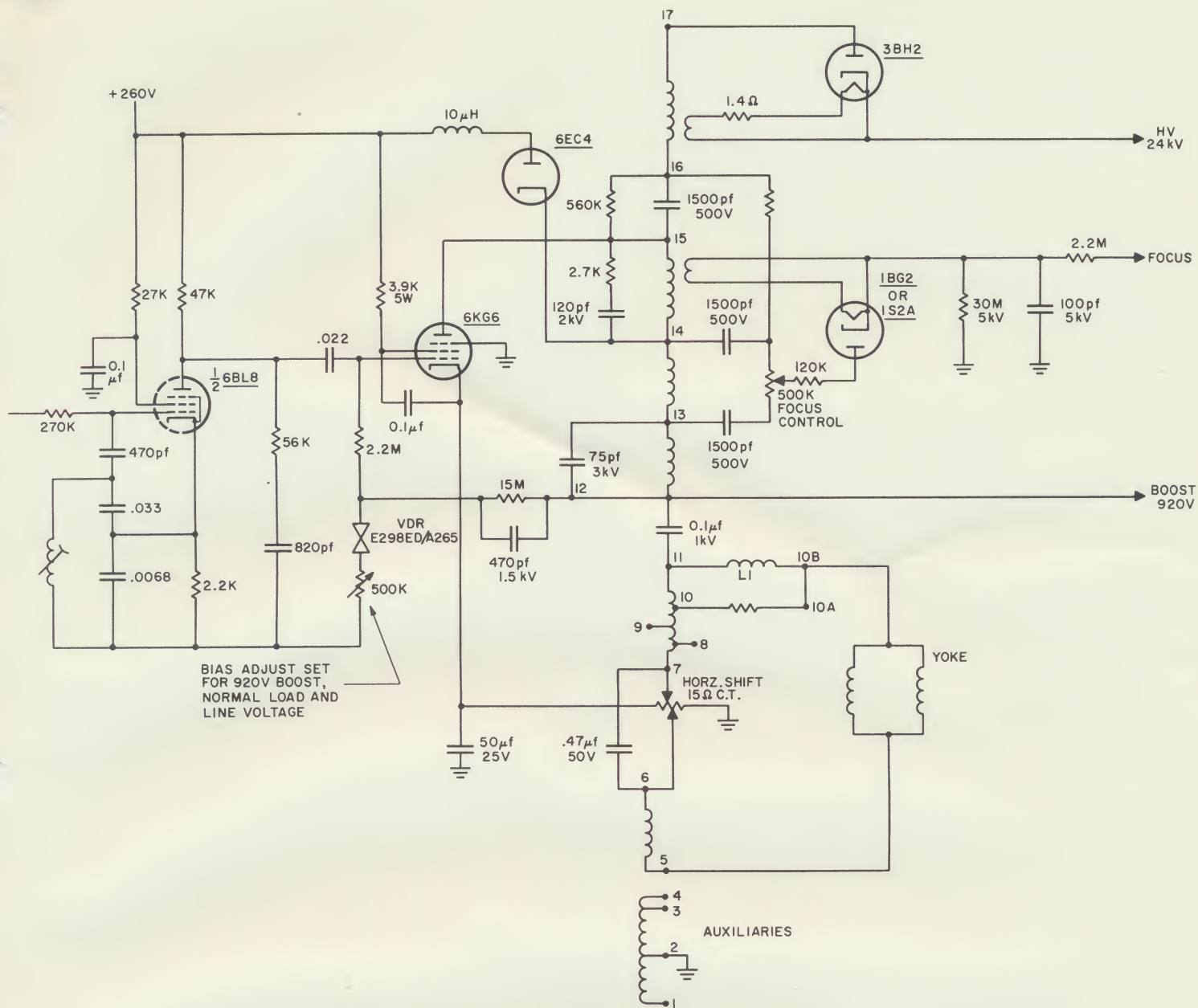


Figure 1.

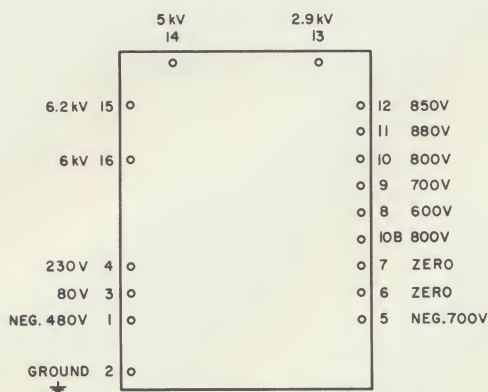


Figure 2.



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AMPEREX 6KG6 HORIZONTAL OUTPUT TUBE

INTRODUCTION

The 6KG6 is a horizontal output tube specially intended for use in color television receivers. The tube is a single pentode in a T12 envelope with a Magnoval base.

The 6KG6 was developed for use in both 70° and 90° deflection circuits. The electrical characteristics are so chosen that a great variety of deflection circuits can be designed with this tube. It can operate at supply voltages ranging from 240 V to 400 V. Furthermore, it can be used in circuits with and without VDR stabilization. The current capability and permitted anode dissipation are so high that an average beam current of 1.5 ma in the picture tube can be handled in circuits with and without high voltage stabilization.

ELECTRICAL CHARACTERISTICS

The high power required for scanning a color picture tube and for generation of the high voltage require a horizontal output tube that is considerably larger than the output tubes used in black-and-white television. The 6KG6 is therefore designed to supply about two times more cathode current than the 6GB5. Because the tube must be able to operate at a low supply voltage, it was necessary to have a knee of the I_b/V_b characteristic as low as possible. A very careful design of the electrode structure of the 6KG6 has resulted in a tube that supplies the required high cathode current at exactly the same knee voltage as the 6GB5.

END-OF-SCAN VOLTAGE

The end-of-scan voltage that has to be taken into account in a horizontal output tube depends on a great variety of conditions, i. e., the knee voltage, and hence voltage spread of the tube, tolerance of components, shift during life, underheating, etc.

The influence of all these conditions on the end-of-scan voltage of the 6KG6 can be measured and calculated or estimated by the tube manufacturer, except for the influence of underheating which depends entirely on the supply voltage used in the particular set. It can be expected that many different values of supply voltage will be used in the next few years of color television.

It is for this reason that under "Typical Operation Conditions," the end-of-scan anode voltage for a V. D. R. stabilized circuit is indicated by: $60\text{ V} + 0.1\text{ V}_b$. The 0.1 V_b obviously allows for 10% reduction of the line voltage, whereas the 60 V is the sum of the knee voltage and a voltage tolerance due to tube and components change and deterioration during life.

SUPPRESSOR-GRID VOLTAGE

Unlike previous horizontal output tubes the suppressor grid of the 6KG6 is separately connected to a base pin. This arrangement has been chosen for the following reason.

Depending on the driving signal and the circuit lay-out of the stage, it may happen that the anode voltage of the output tube attains - during the scan - values below the knee voltage of the tube. If the tube is driven that way, there is a risk of Barkhausen oscillations.

These oscillations occur only if the momentary value of the anode voltage is low and the screen-grid voltage is high. This situation combined with a certain electrode geometry may result in such an electrical field strength division that part of the electrons flowing to the anode return before reaching it. These returning electrodes may describe complicated paths in the space between the screen-grid and anode and generate an electromagnetic field. The changes in the electron flow are so quick that the magnetic field strengths vary in an extremely high rate and cause interferences in the VHF and UHF region of the frequency spectrum.

It will be clear from the foregoing that the best way to prevent Barkhausen oscillations is to avoid very low anode voltages. This, however, is not always possible due to conditions of supply voltage, transformer design, etc. In that case the only remaining possibility is to disturb the field conditions between the screen-grid and the anode to such an extent that oscillations will no longer occur. This can be done in the 6KG6 - if necessary - by applying a small positive voltage to the third grid. Practical experience has taught that this voltage should be in the order of 20 V. The simplest solution to obtain the positive voltage at the suppressor grid is to connect the grid to the supply voltage via a bleeder so that a voltage of about 20 V at the grid is achieved.

In order to prevent undue effects on the electrical characteristics of the tube the series impedance of the suppressor grid should not exceed 100 k ohms.



AMPEREX ELECTRONIC CORPORATION

Manufacturers of Electron Tubes and Semiconductors

**Semiconductor and
Receiving Tube Division
Sales and
Executive Offices:**

Providence Pike
Slatersville, R. I. 02876
Tel. 401—PO 2-9000
TWX. 401-767-2499

**Receiving Tube
Order Department:**

Hicksville, L. I., N. Y. 11802
Tel. 516—WE 1-6200
TWX. 516-433-9045

Cable Address:

"Ampronic, Hicksville"

Dear Sir:

Thank you for your interest in the new 6KG6 Output Pentode introduced by Amperex Electronic Corporation for use in color television horizontal deflection circuits. Through use of a cavitrap anode and other built in design characteristics developed by Amperex to eliminate Barkhausen oscillations, snivet suppression circuits can be eliminated resulting in lower circuit cost.

The tube can be operated with grounded suppressor at B+ supply voltages from 240 to 400 volts and remain snivet free. Sufficient safety margins have been designed in so that bulb temperatures at maximum operating conditions are about 50°C cooler than comparable tubes. Operation at these reduced temperatures substantially increases the life expectancy of the Amperex 6KG6 over its competition.

Besides the anti-snivet feature, the 6KG6 has extra electrical reserve capacity and added safety factors. It has a maximum 7000 V peak plate voltage, 34 watts maximum plate dissipation and 1.4 amps peak anode current.

The 6KG6 is part of the family of tubes for color TV that make possible lower costs, higher quality and more reliable color TV performance. Other tubes in the line include the 6EC4 damper diode, a matching companion to the 6KG6 for horizontal deflection circuits; the 3BH2 high voltage rectifier diode, and the 6ED4 shunt stabilizer.

These new tubes were optimized for reliable operation between 240 to 270 V B+ supply in order to reduce the cost of color television chassis design.

This means receivers can be designed without a heavy and costly power transformer and with less expensive filter circuits. Result - lower overall set cost.

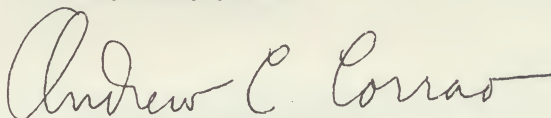
Detailed data sheets on the Amperex 6KG6, 3BH2, 6EC4 and 6ED4 are included in this mailing. In addition, circuit application data, complete with actual circuit designs and specifications are included. Types 6KG6, 6EC4 and 3BH2 are available from stock for immediate delivery. The 6ED4 is ready for sampling with production availability in June. List prices on the above types are as follows:

6KG6	\$1.92
3BH2	.74
6EC4	.84
6ED4	1.75

Amperex will be happy to assist you should you require more detailed application information or application assistance concerning these tubes and circuits.

A complete listing of reliable, low cost, preferred types for color television chassis design is also included.

Very truly yours,

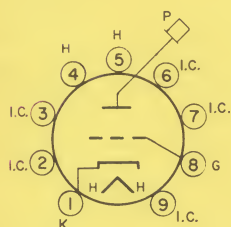


Product Manager,
Television Industry Sales

AMPEREX TUBE TYPE 6ED4/ED500

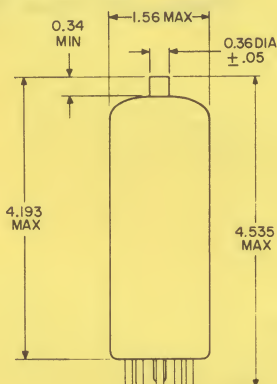
TENTATIVE DATA

The Amperex 6ED4/ED500 is a shunt stabilizer triode designed for use in color television receivers.



PIN CONNECTIONS

- 1- CATHODE
- 2- INTERNAL CONNECTION
- 3- INTERNAL CONNECTION
- 4- HEATER
- 5- HEATER
- 6- INTERNAL CONNECTION
- 7- INTERNAL CONNECTION
- 8- GRID
- 9- INTERNAL CONNECTION
- P- CAP-PLATE



GENERAL CHARACTERISTICS

MECHANICAL

Dimensions
Base

see outline drawing
magnoval

ELECTRICAL

Heater Supply
Heater Voltage
Heater Current

indirect AC or DC
series supply
6.3 volts
350 ma

MAXIMUM RATINGS (DESIGN CENTER - unless noted)

Plate Voltage	25,000 volts
Plate Current	1.5 ma
Plate Dissipation	30 watts
Plate Dissipation (absolute limit)	40 watts ¹
Negative Grid Voltage	150 volts ²
Grid Circuit Resistance	5 megohms
Cathode to Heater Voltage	
Cathode Positive	400 VDC + 250 VAC
Cathode Negative	250 volts

1. Permissible only during short periods; in total, up to a maximum of 10% of the operating time of the tube.
2. During set warm-up, 440 volts maximum.

Precautions: X-ray shielding may be required to give protection against excessive radiation.

6ED4/ED500

TYPICAL OPERATING CHARACTERISTICS

Plate Voltage

25,000 volts

Grid Voltage Change for a Plate Current

Change of 0.1 to 1.5 ma

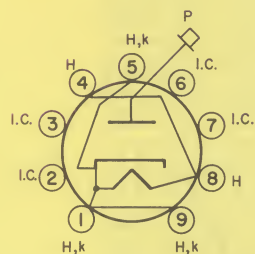
<11 volts

Negative Grid Voltage ($I_p = 100 \mu a$)

18 to 40 volts

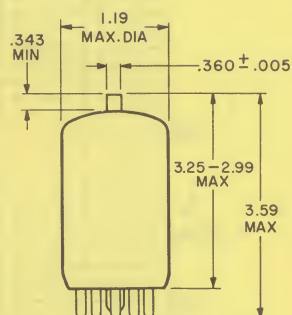
AMPEREX TUBE TYPE 3BH2

The 3BH2 is a high voltage rectifier diode intended for use in color TV receivers.



PIN CONNECTIONS

1-HEATER,CATHODE
2-INTERNAL CONNECTION
3-INTERNAL CONNECTION
4-HEATER
5-HEATER,CATHODE
6-INTERNAL CONNECTION
7-INTERNAL CONNECTION
8-HEATER
9-HEATER,CATHODE
P-PLATE



GENERAL CHARACTERISTICS

MECHANICAL

Base
Dimensions

magnoval
see outline drawing

ELECTRICAL

Heating
Heater Voltage
Heater Current
Capacitance

Indirect, AC or DC
3.15 volts \pm 15%
370 ma
1.5 pf, Plate
to Cathode

ABSOLUTE MAXIMUM RATINGS

Negative Plate to Cathode Voltage¹
Output Voltage
Plate Current (Design Center)

35 k volts
27.5 k volts
1.7 ma

OPERATING CHARACTERISTICS

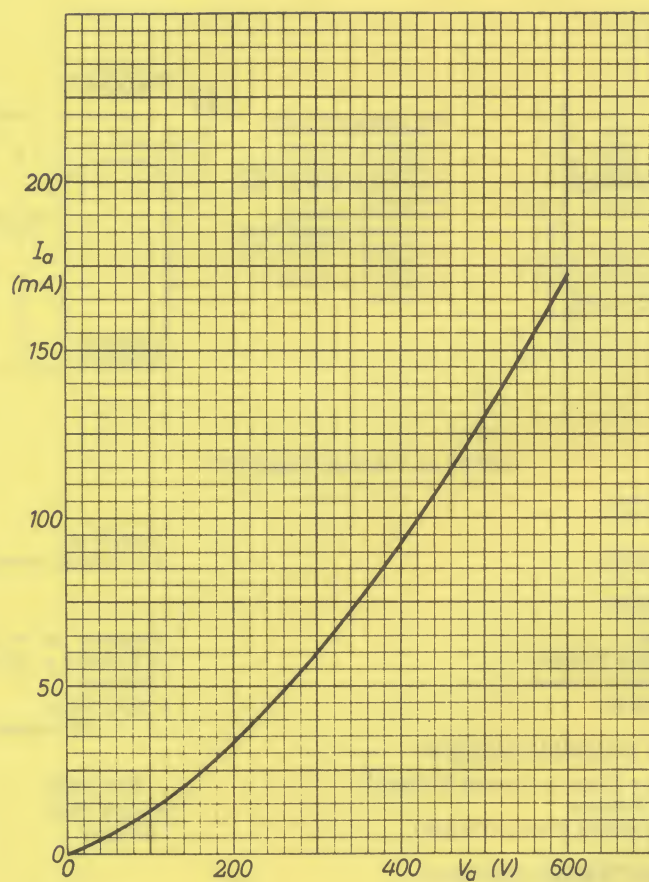
Output Voltage
Plate Current

25 k volts
1.5 ma

OPERATING NOTES

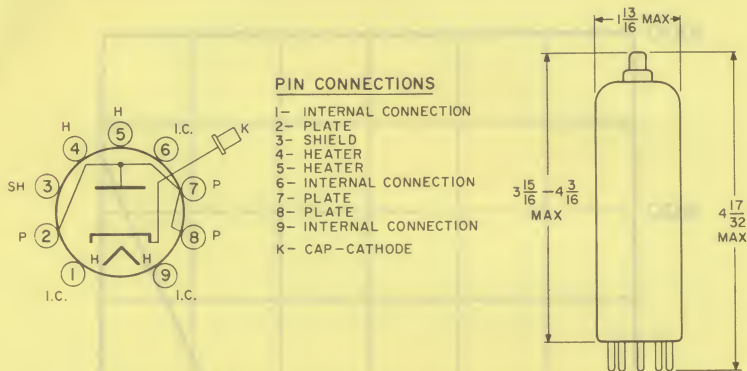
- Pins 1, 5 and 9, may be used to connect an anti-corona ring.
- X-ray shielding may be required for protection against excessive radiation

- Negative peak due to ringing in output transformer should be taken into account. Maximum pulse duration 22% of a cycle and 18 μ sec.



AMPEREX TUBE TYPE 6EC4

The 6EC4 is a damper diode for use in horizontal deflection circuits of color TV receivers.



GENERAL CHARACTERISTICS

MECHANICAL

Base magnoval
Dimensions see outline drawing

ELECTRICAL

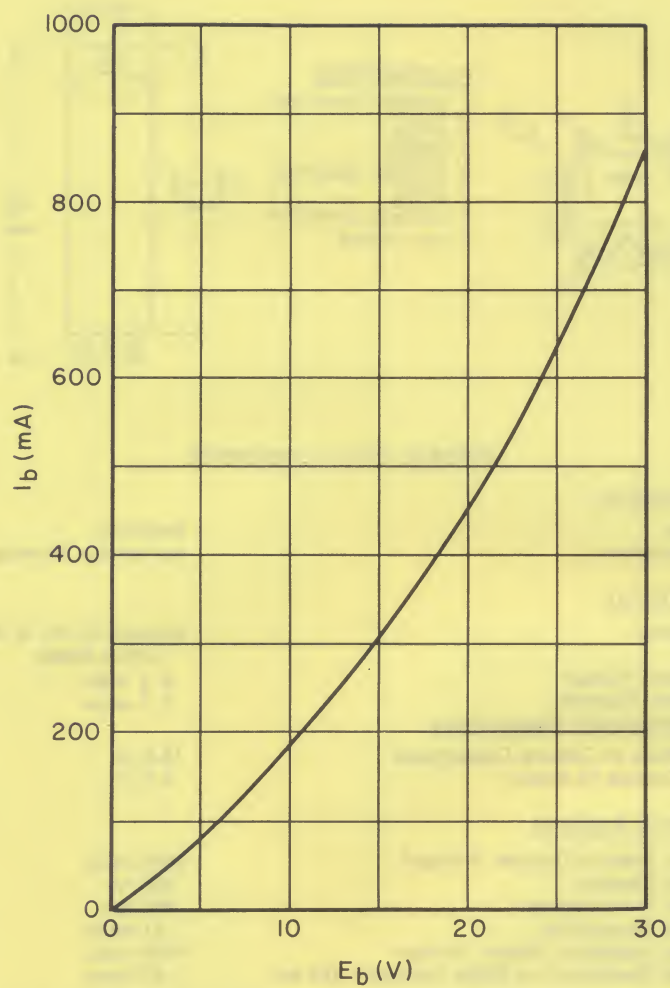
Heating¹ indirect by AC or DC, series supply
Heater Voltage 6.3 volts
Heater Current 2.1 amps
Interelectrode Capacitances
Plate to Cathode Capacitance 13.5 pf
Cathode to Heater 3.7 pf

MAXIMUM RATINGS

Peak Plate to Cathode Voltage² 5600 volts
Plate Current 440 ma
Peak Plate Current 800 ma
Plate Dissipation 11 watts
Peak Cathode to Heater Voltage² 6300 volts
Diode Resistance at Plate Current = 440 ma 45 ohms

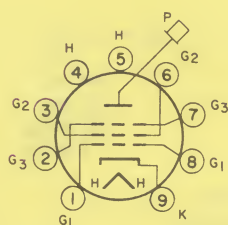
¹ The minimum resistance between any heater pin of a heater chain and the supply should be 100 ohms. This resistance may entirely or partially consist of the hot resistance of a part of the heater chain.

² Maximum pulse duration is 22% of one cycle and 18 μ sec.



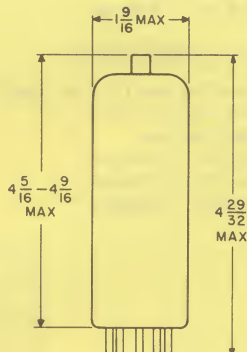
AMPEREX TUBE TYPE 6KG6

The 6KG6 is an output pentode designed for use in horizontal deflection circuits of color television receivers operating at supply voltages of 240 to 270 volts.



PIN CONNECTIONS

- 1- GRID NO.1
- 2- GRID NO.3
- 3- GRID NO.2
- 4- HEATER
- 5- HEATER
- 6- GRID NO.2
- 7- GRID NO.3
- 8- GRID NO.1
- 9- CATHODE
- P- CAP-PLATE



GENERAL CHARACTERISTICS

MECHANICAL

Base
Dimensions

magnoval
see outline drawing

ELECTRICAL

Heating

indirect by AC or DC,
series supply
6.3 volts
2 amps

Heater Voltage
Heater Current

Interelectrode Capacitances

Plate to Grid No. 1
Grid No. 1 to Heater

2.5 pf
200 mpf

MAXIMUM RATINGS

Plate Voltage (Zero Current)	700 volts
Peak Plate Voltage	7000 volts
Grid No. 2 Voltage (Zero Current)	700 volts
Grid No. 2 Voltage	250 volts
Plate Dissipation ¹	34 watts
Grid No. 2 Dissipation	7 watts
Cathode Current	500 ma
Cathode to Heater Voltage	250 volts
Grid No. 1 Resistance	
Fixed Bias	0.25 megohm
Stabilized Circuits	2.2 megohms

¹ A plate dissipation of 34 watts should not be exceeded under the worst probable operating conditions at normal picture width.

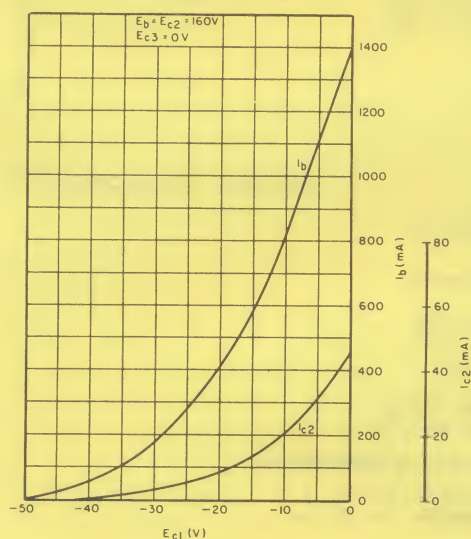
6KG6

TYPICAL CHARACTERISTICS²

Plate Voltage	160	45 volts
Grid No. 2 Voltage	160	160 volts
Grid No. 1 Voltage	0	0 volts
Plate Current	1400	1000 (min.) ma
Grid No. 2 Current	45	-- ma
Grid No. 3 Voltage	0	0 volts

TYPICAL OPERATION³

Plate Voltage (End of Scan) ⁴	$60V + 0.1 V_b$
Peak Plate Current	1 amp
Plate Current	440 ma
Grid No. 2 Current	40 ma
Grid No. 2 Voltage	175 volts
Grid No. 3 Voltage ⁵	0 volts



² In order not to exceed the maximum ratings for Plate and Grid No. 2 Dissipation, these characteristics should be measured under pulse conditions.

³ The minimum required cut off voltage during flyback is 170 volts at:

- Plate Voltage = 7000 volts
- Grid No. 2 Voltage = 175 volts
- Grid No. 1 Impedance = 1 k ohm at horizontal frequency.

⁴ The value $0.1V_b$ is included to allow for 10% variation of the supply voltage. When selecting supply voltage care should be taken not to exceed the maximum rated plate cut off voltage.

⁵ For optimum suppression of Barkhausen oscillations and snivets, the beam plates may be connected to a voltage of +15 volts.